3

Financial arithmetic

3.1 Kick off with CAS

Calculating interest with CAS

CAS can be used to quickly and easily evaluate formulas when given specific values.

The formula to calculate simple interest is $I = \frac{PrT}{100}$, where I is the interest accrued, P is the principal, r is the rate of interest and T is the time.

1 Using CAS, define and save the formula for simple interest.

2 Use the formula to calculate the missing values in the following situations.

a $P = \$3000$, $r = 4\%$, $T = 2$ years

b $I = \$945$, $r = 4.5\%$, $T = 3$ years

c $I = \$748$, $P = \$5500$, $T = 4$ years

d $I = \$313.50$, $P = \$330$, $r = 3.8\%$

The formula to calculate compound interest is $A = P\left(1 + \frac{r}{100}\right)^n$, where A is the final amount, P is the principal, r is the rate of interest and n is the number of interest-bearing periods.

3 Using CAS, define and save the formula for compound interest.

4 Use the formula to calculate the missing values in the following situations.

a $P = \$5000$, $r = 3.3\%$, $T = 2$ years

b $A = \$8800$, $r = 5\%$, $T = 4$ years

c $A = \$2812.16$, $P = \$2500$, $i = 3$ years

d $A = \$3500.97$, $P = \$3300$, $r = 3\%$

The value of the final amount for simple interest can be calculated by summing I and P.

5 Use CAS to help you complete the following table comparing simple and compound interest.

Principal	Rate of interest	Time period	Simple interest final amount	Compound interest final amount
$4000	4%	3 years		
$2500	3.5%		$2850	
$5000		2 years		$5533.52
	2.7%	5 years	$7207.25	

6 Repeat question 4 using the Finance/Financial Solver on CAS.

Please refer to the Resources tab in the Prelims section of your **eBookPLUS** for a comprehensive step-by-step guide on how to use your CAS technology.

3.2 Percentage change

Percentages can be used to give an indication of the amount of change that has taken place, which makes them very useful for comparison purposes. Percentages are frequently used in comments in the media. For example, a company might report that its profits have fallen by 6% over the previous year.

The percentage change is found by taking the actual amount of change that has occurred and expressing it as a percentage of the starting value.

WORKED EXAMPLE 1

The price of petrol was $1.40 per litre but has now risen to $1.65 per litre. What is the percentage change in the price of petrol, correct to 2 decimal places?

THINK	WRITE
1 Identify the amount of change.	$1.65 - 1.40 = 0.25$ The price of petrol has increased by 25 cents per litre.
2 Express the change as a fraction of the starting point, and simplify the fraction if possible.	$\frac{0.25}{1.40} = \frac{25}{140}$ $= \frac{5}{28}$
3 Convert the fraction to a percentage by multiplying by 100.	$\frac{5}{28} \times 100 = \frac{5}{7} \times \frac{25}{1}$ $= \frac{125}{7}$ ≈ 17.86
4 State the final answer.	The price of petrol has increased by approximately 17.86%.

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AOS 2
Topic 2
Concept 1

Percentage change
Concept summary
Practice questions

Calculating percentage change

In the business world percentages are often used to determine the final selling value of an item. For example, during a sale period a store might decide to advertise '25% off everything' rather than specify actual prices in a brochure. At other times, when decisions are being made about the financial returns needed in order for a business to remain viable, the total production cost plus a percentage might be used. In either case, the required selling price can be obtained through multiplying by an appropriate percentage.

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Calculating percentage change
int-6459

Consider the situation of reducing the price of an item by 18% when it would normally sell for $500. The reduced selling price can be found by evaluating the amount of the reduction and then subtracting it from the original value as shown in the following calculations:

Reduction of 18%: $\frac{18}{100} \times 500 = \$90$

Reduced selling price: $\$500 - \$90 = \$410$

The selling price can also be obtained with a one-step calculation of $\frac{82}{100} \times 500 = \$410$.

In other words, reducing the price by 18% is the same as multiplying by 82% or (100 − 18)%.

> **To reduce something by *x*%, multiply by (100 − *x*)%.**
> **To increase something by *x*%, multiply by (100 + *x*)%.**

WORKED EXAMPLE 2 Increase $160 by 15%.

THINK	WRITE
1 Add the percentage increase to 100.	$100 + 15 = 115$
2 Express the result as a percentage (by dividing by 100) and multiply by the value to be increased.	$\frac{115}{100} \times \$160 = \frac{115}{100} \times \frac{160}{1}$ $= \frac{23}{2} \times \frac{16}{1}$ $= 23 \times 8$ $= \$184$
3 State the final answer.	Increasing $160 by 15% gives $184.

When a large number of values are being considered in a problem involving percentages, spreadsheets or other technologies can be useful to help carry out most of the associated calculations. For example, a spreadsheet can be set up so that entering the original price of an item will automatically calculate several different percentage increases for comparison.

	A	B	C	D	E
1	Original	Increase by:			
2	price	+5%	+8%	+12%	+15%
3	$ 100.00	$ 105.00	$ 108.00	$ 112.00	$ 115.00
4	$ 150.00	$ 157.50	$ 162.00	$ 168.00	$ 172.50
5	$ 200.00	$ 210.00	$ 216.00	$ 224.00	$ 230.00
6	$ 300.00	$ 315.00	$ 324.00	$ 336.00	$ 345.00
7	$ 450.00	$ 472.50	$ 486.00	$ 504.00	$ 517.50

EXERCISE 3.2 Percentage change

Unless directed otherwise, give all answers to the following questions correct to 2 decimal places or the nearest cent where appropriate.

PRACTISE

1 **WE1** If the price of bananas was $2.65 per kg, calculate the percentage change (increase or decrease) if the price is now:

a $3.25 per kg
b $4.15 per kg
c $1.95 per kg
d $2.28 per kg.

2 Calculate the percentage change in the following situations.

a A discount voucher of 4 cents per litre was used on petrol advertised at $1.48 per litre.
b A trade-in of $5200 was applied to a car originally selling for $28 500.
c A shop owner purchases confectionary from the manufacturer for $6.50 per kg and sells it for 75 cents per 50 grams.
d A piece of silverware has a price tag of $168 at a market, but the seller is bartered down and sells it for $147.

3 WE2 Increase:

a $35 by 8%
b $96 by 12.5%
c $142.85 by 22.15%
d $42 184 by 0.285%.

4 Decrease:

a $54 by 16%
b $7.65 by 3.2%
c $102.15 by 32.15%
d $12 043 by 0.0455%.

CONSOLIDATE

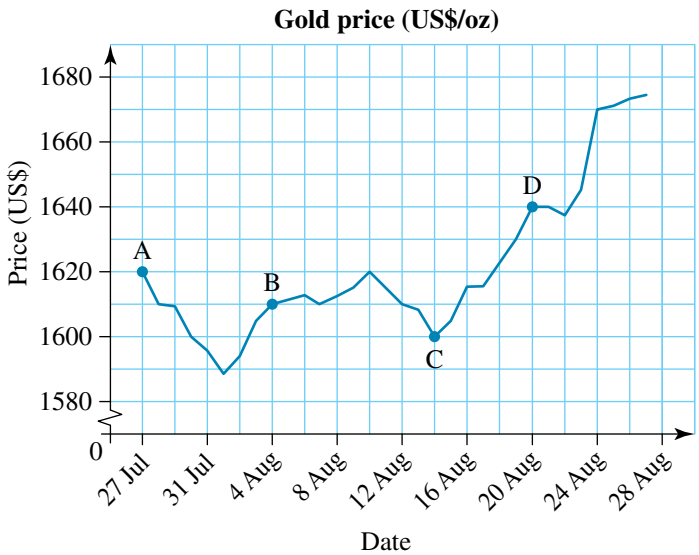
5 The price of a bottle of wine was originally $19.95. After it received an award for wine of the year, the price was increased by 12.25%. Twelve months later the price was reduced by 15.5%.

a What is the final price of a bottle of this wine?
b What is the percentage change of the final price from the original price?

6 a An advertisement for bedroom furniture states that you save $55 off the recommended retail price when you buy it for $385. By what percentage has the price been reduced?
b If another store was advertising the same furniture for 5% less than the sale price of the first store, by what percentage has this been reduced from the recommended retail price?

7 A mobile phone is sold for $127.50. If this represents a 15% reduction from the RRP, what was the original price?

8 The following graph shows the change in the price of gold (in US dollars per ounce) from July 27 to August 27 in 2012.

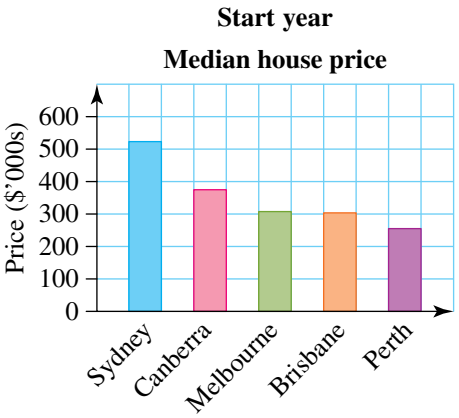


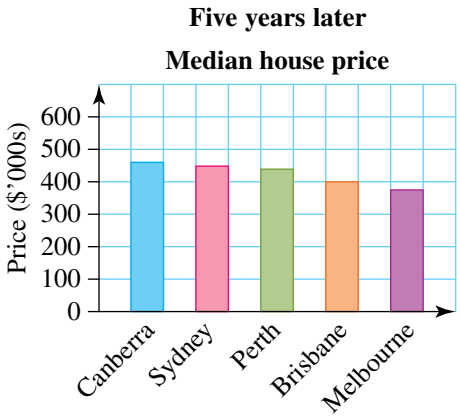
a Calculate the percentage change from:
  i the point marked A to the point marked B
  ii the point marked C to the point marked D.

b What is the percentage change from the point marked A to the point marked D?

9 A car yard offers three different vehicles for sale. The first car was originally priced at $18 750 and is now on sale for $14 991. The second car was originally priced at $12 250 and is now priced $9999, and the third car was originally priced at $23 990 and is now priced $19 888. Which represents the largest percentage reduction?

10 The following graphs show the changes in property prices in the major capital cities of Australia over a five-year period.





a When comparing the median house prices for the five capital cities over this time period, which city had the largest percentage change and by how much?

b In the same time period, which city had the smallest percentage change?

11 Over a period of time prices in a store increased by 15%, then decreased by 10%, and finally increased by a further 5%. What is the overall percentage change over this time period, correct to the nearest whole percentage?

12 A power company claims that if you install solar panels for $1800, you will make this money back in savings on your electricity bill in 2 years. If you usually pay $250 per month, by what percentage will your bill be reduced if their claims are correct?

13 A house originally purchased for $320 000 is sold to a new buyer at a later date for $377 600.

a What is the percentage change in the value of the house over this time period?

b The new buyer pays a deposit of 15% and borrows the rest from a bank. They are required to pay the bank 5% of the total amount borrowed each year. If they purchased the house as an investment, how much should they charge in rent per month in order to fully cover their bank payments?

14 The following table shows the number of participants in selected non-organised physical activities in Australia over a ten-year period.

Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Walking	4283	4625	5787	6099	5875	5724	5309	6417	6110	6181
Aerobics	1104	1273	1340	1551	1623	1959	1876	2788	2855	3126
Swimming	2170	2042	2066	2295	2070	1955	1738	2158	2219	2153
Cycling	1361	1342	1400	1591	1576	1571	1532	1850	1809	1985
Running	989	1067	1094	1242	1143	1125	1171	1554	1771	1748
Bushwalking	737	787	824	731	837	693	862	984	803	772
Golf	695	733	690	680	654	631	488	752	703	744
Tennis	927	818	884	819	792	752	602	791	714	736
Weight training	313	230	274	304	233	355	257	478	402	421
Fishing	335	337	387	349	312	335	252	356	367	383

a What is the percentage change in the number of participants swimming from year 1 to year 10?
b What is the percentage change in the number of participants walking from year 1 to year 10?
c What is the overall percentage change in the number of participants swimming and walking combined during the time period?

MASTER

15 The following table shows the changes in an individual's salary over several years.

Year	Annual salary	Percentage change
2013	$34 000	
2014	$35 750	
2015	$38 545	
2016	$42 280	
2017	$46 000	

Use CAS or a spreadsheet to answer these questions.

a Evaluate the percentage change of each salary from the previous year.
b In which year did the individual receive the biggest percentage increase in salary?

16 A population of possums in a particular area, N, changes every month according to the rule $N = 1.55M - 18$, where M is the number of possums the previous month. The number of possums at the end of December is 65.

Use CAS to:

a construct a table and draw a graph of the number of possums over the next 6 months (rounding to the nearest number of possums)
b evaluate the percentage change each month, correct to 1 decimal place.

3.3 Financial applications of ratios and percentages

Shares and currency

Share dividends

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Topic 2
Concept 2

Inflation, share prices and dividends
Concept summary
Practice questions

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Interactivity
Shares and currency
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Many people earn a second income through investments such as **shares**, seeking to make a profit through buying and selling shares in the stock market. Speculators attempt to buy shares when they are low in value and sell them when they are high in value, whereas other investors will keep their shares in a company for a longer period of time in the hope that they continue to gradually rise in value. When you purchase shares you are effectively becoming a part-owner of a company, which means you are entitled to a portion of any profits that are made. This is known as a **dividend**.

To calculate a dividend, the profit shared is divided by the total number of shares in the company.

WORKED EXAMPLE 3

Calculate the dividend payable for a company with 2 500 000 shares when $525 000 of its annual profit is distributed to the shareholders?

THINK	WRITE
1 Divide the profit by the number of shares.	525 000 ÷ 2 500 000 = 0.21
2 State the final answer.	The dividend payable will be 21 cents per share.

Percentage dividends

Shares in different companies can vary drastically in price, from cents up to hundreds of dollars for a single share. As a company becomes more successful the share price will rise, and as a company becomes less successful the share price will fall.

An important factor that investors look at when deciding where to invest is the **percentage dividend** of a company. The percentage dividend is calculated by dividing the dividend per share by the share price per share.

$$\text{Percentage dividend} = \frac{\text{dividend per share}}{\text{share price per share}}$$

WORKED EXAMPLE 4 **Calculate the percentage dividend of a share that costs $13.45 with a dividend per share of $0.45. Give your answer correct to 2 decimal places.**

THINK	WRITE
1 Divide the dividend per share by the price of a share.	$\frac{0.45}{13.45} = 0.033\,457...$
2 Express the result as a percentage (by multiplying by 100).	$= 0.033\,457... \times 100\%$ $= 3.3457...\%$
3 Round your answer to 2 decimal places and state the answer.	$= 3.35\%$ (to 2 decimal places) The percentage dividend per share is 3.35%.

The price-to-earnings ratio

The **price-to-earnings ratio (P/E ratio)** is another way of comparing shares by looking at the current share price and the annual dividend. It is calculated by dividing the current share price by the dividend per share, giving an indication of how much shares cost per dollar of profit.

$$\text{P/E ratio} = \frac{\text{share price per share}}{\text{dividend per share}}$$

WORKED EXAMPLE 5 **Calculate the price-to-earnings ratio for a company whose current share price is $3.25 and has a dividend of 15 cents. Give your answer correct to 2 decimal places.**

THINK	WRITE
1 Divide the current share price by the dividend.	$3.25 \div 0.15 = 21.67$ (to 2 decimal places)
2 State the answer.	The price-to-earnings ratio is 21.67.

Mark-ups and discounts

In the business world profits need to be made, otherwise companies may be unable to continue their operations. When deciding on how much to charge customers, businesses have to take into account all of the costs they incur in providing their services. If their costs increase, they must mark up their own charges in order to remain viable. For example, any businesses that rely on the delivery of materials by road transport are susceptible to fluctuations in fuel prices, and they will take these into account when pricing their services. If fuel prices increase, they will need to increase their charges, but if fuel prices decrease, they might consider introducing discounts.

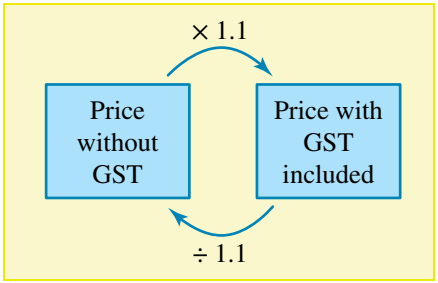
WORKED EXAMPLE 6

A transport company adjusts their charges as the price of petrol changes. By what percentage, correct to 2 decimal places, do their fuel costs change if the price per litre of petrol increases from $1.36 to $1.42?

THINK	WRITE
1 Calculate the amount of change.	$\$1.42 - \$1.36 = \$0.06$
2 Express the change as a fraction of the starting point.	$\frac{0.06}{1.36}$
3 Simplify the fraction where possible and then multiply by 100 to calculate the percentage change.	$\frac{0.06}{1.36} = \frac{6}{136}$ $= \frac{3}{68}$ $\frac{3}{68} \times 100 = \frac{3}{17} \times \frac{25}{1}$ $= \frac{75}{17}$ ≈ 4.41
4 State the answer.	The company's fuel costs increase by 4.41%.

Goods and services tax

In Australia we have a 10% tax that is charged on most purchases, known as a **goods and services tax** (or **GST**). Some essential items, such as medicine, education and certain types of food, are exempt from GST, but for all other goods GST is added to the cost of items bought or services paid for. If a price is quoted as being 'inclusive of GST', the amount of GST paid can be evaluated by dividing the price by 11.



WORKED EXAMPLE 7

Calculate the amount of GST included in an item purchased for a total of $280.50.

THINK	WRITE
1 Does the price include the GST already?	Yes, GST is included.
2 If GST is not included, calculate 10% of the value. If GST is included, divide the value by 11.	GST is included, so divide $280.50 by 11. $280.50 \div 11 = 25.5$
3 State the final answer.	The amount of GST is $25.50.

EXERCISE 3.3 Financial applications of ratios and percentages

Unless otherwise directed, give all answers to the following questions correct to 2 decimal places or the nearest cent where appropriate.

PRACTISE

1 WE3 Calculate the dividend payable per share for a company with:
- a 32 220 600 shares, when $1 995 000 of its annual profit is distributed to the shareholders
- b 44 676 211 shares, when $5 966 000 of its annual profit is distributed to the shareholders
- c 263 450 shares, when $8 298 675 of its annual profit is distributed to the shareholders.

2 How many shares are in a company that declares a dividend of:
- a 28.6 cents per share when $1 045 600 of its annual profit is distributed?
- b $2.34 per share when $3 265 340 of its annual profit is distributed?
- c $16.62 per share when $9 853 000 of its annual profit is distributed?
- d $34.95 per share when $15 020 960 of its annual profit is distributed?

3 WE4 Calculate the percentage dividends of the following shares.
- a A share price of $14.60 with a dividend of 93 cents
- b A share price of $22.34 with a dividend of 87 cents
- c A share price of $45.50 with a dividend of $2.34
- d A share price of $33.41 with a dividend of $2.88

4 Alexandra is having trouble deciding which of the following companies to invest in. She wants to choose the company with the highest percentage dividend. Calculate the percentage dividend for each company to find out which Alexandra should choose.
- A A clothing company with a share price of $9.45 and a dividend of 45 cents
- B A mining company with a share price of $53.20 and a dividend of $1.55
- C A financial company with a share price of $33.47 and a dividend of $1.22
- D A technology company with a share price of $7.22 and a dividend of 41 cents
- E An electrical company with a share price of $28.50 and a dividend of $1.13

5 WE5 Calculate the price-to-earnings ratio for a company with:
- a a current share price of $12.50 and a dividend of 25 cents
- b a current share price of $43.25 and a dividend of $1.24
- c a current share price of $79.92 and a dividend of $3.32
- d a current share price of $116.46 and a dividend of $7.64.

6 Calculate the current share price for a company with:
- a a price-to-earnings ratio of 22.4 and a dividend of 68 cents
- b a price-to-earnings ratio of 36.8 and a dividend of 81 cents
- c a price-to-earnings ratio of 17.6 and a dividend of $1.56
- d a price-to-earnings ratio of 11.9 and a dividend of $3.42.

7 WE6 A coffee shop adjusts its charges as the price of electricity changes. By what percentage does its power cost change if the price of electricity increases from:

a 88 cents to 94 cents per kWh **b** 92 cents to $1.06 per kWh?

8 An electrical goods department store charges $50 plus n cents per km for delivery of its products, where n = the number of cents over $1.20 of the price per litre of petrol. What will be the percentage increase in the total delivery charge for a distance of 25 km when the petrol price changes from $1.45 to $1.52 per litre?

9 WE7 Calculate the amount of GST included in an item purchased for a total of:

a $34.98 **b** $586.85 **c** $56 367.85 **d** $2.31.

10 Two companies are competing for the same job. Company A quotes a total of $5575 inclusive of GST. Company B quotes $5800 plus GST, but offers a 10% reduction on the total price for payment in cash. Which is the cheaper offer, and by how much?

CONSOLIDATE

11 Calculate the dividend per share for a company with:

a a price-to-earnings ratio of 25.5 and a current share price of $8.75
b a price-to-earnings ratio of 20.3 and a current share price of $24.35
c a price-to-earnings ratio of 12.2 and a current share price of $10.10
d a price-to-earnings ratio of 26 and a current share price of $102.

12 A plumber quotes his clients the cost of any parts required plus $74.50 per hour for his labour, and then adds on the required GST.

a How much does he quote for a job that requires $250 in parts (excluding GST) and should take 4 hours to complete?
b If the job ends up being faster than he first thought, and he ends up charging the client for only 3 hours labour, what percentage discount on the original quote does this represent?

13 A company that has 350 000 shares declares an annual gross profit of $2 450 665, pays 18.5% of this in tax, and reinvests 25% of the net profit.

a What is the dividend per share payable to the shareholders?
b What is the price-to-earnings ratio if the current share price is $43.36?

14 A boat is purchased during a sale for a cash payment of $2698.

a If it had been discounted by 15%, and then a further $895 was taken off for a trade-in, what was the original price correct to the nearest dollar?
b What is the percentage change between the original price and the cash payment?

15 The details of two companies are shown in the following table.

Company	Share price	Net profit	Total shares
Company A	$34.50	$8 600 000	650 000
Company B	$1.48	$1 224 000	555 000

a What is the dividend per share payable for shareholders in each company if each of the companies re-invests 12.5% of the net profit?

b What is the price-to-earnings ratio for each company?
c If a shareholder has 500 shares in Company A and 1000 shares in Company B, how much will they receive from their dividends?
d Which company represents the best investment?

16 A South African company with a share price of 49.6 rand and 3 456 000 shares declares a dividend of 3.04 rand per share.

a What is the total dividend payment in rand?
b What is the price-to-earnings ratio of this company?

17 Jules is shopping for groceries and buys the following items.

Bread — $3.30*

Fruit juice — $5.50*

Meat pies — $5.80

Ice-cream — $6.90

Breakfast cereal — $5.00*

Biscuits — $2.90

All prices are listed before GST has been added-on.

a The items marked with an asterisk (*) are exempt from GST. Calculate the total amount of GST Jules has to pay for his shopping.
b Calculate the additional amount Jules would have to pay if all of the items were eligible for GST.
c Jules has a voucher that gives him a 10% discount from this shop. Use your answer from part **a** to calculate how much Jules pays for his groceries.

18 A carpet company offers a trade discount of 12.5% to a builder for supplying the floor coverings on a new housing estate.

a If the builder spends $32 250, how much was the carpet before the discount was applied? Round your answer to the nearest 5 cents.
b If the builder charges his customers a total of $35 000, what percentage discount have they received compared to buying direct from the carpet company?

19 The share price of a mining company over several years is shown in the following table.

Year	2012	2013	2014	2015	2016
Share price	$44.50	$39.80	$41.20	$31.80	$29.60
Dividend per share	$1.73	$3.25	$2.74	$3.15	$3.42

a If there are a total of 10 000 000 shares in the company, and 35% of the net profit was reinvested each year, use CAS or other technology to calculate the net profit for each of the years listed.
b What are the price-to-earnings ratios for each of the years listed?
c Which was the best year to purchase shares in the company?

20 The Australian government is considering raising the GST tax from 10% to 12.5% in order to raise funds and cut the budget deficit.

The following shopping bill lists all items exclusive of GST. Calculate the amount by which this shopping bill would increase if the rise in GST did go through.

Note: GST must be paid on all of the items in this bill.

1 litre of soft drink — $2.80

Large bag of pretzels — $5.30

Frozen lasagne — $6.15

Bottle of shampoo — $7.60

Box of chocolate — $8.35

2 tins of dog food — $3.50

MASTER

21 Use CAS to answer the following questions about the companies shown in this table.

Company	Company A	Company B	Company C	Company D	Company E
Currency	Australian dollars	USA dollars	European euros	Chinese yuan	Indian rupees
Share price	$23.35	$26.80	€16.20	¥133.5	₹1288
Dividend	$1.46	$1.69	€0.94	¥8.7	₹65.5

a Calculate the price-to-earnings ratio for each company.

b Calculate the percentage dividend for each company.

22 The following table shows the mark-ups and discounts applied by a clothing store.

Item	Cost price	Normal retail price (255% mark-up)	Standard discount (12.5% mark-down of normal retail price)	January sale (32.25% mark-down of normal retail price)	Stocktake sale (55% mark-down of normal retail price)
Socks	$1.85				
Shirts	$12.35				
Trousers	$22.25				
Skirts	$24.45				
Jackets	$32.05				
Ties	$5.65				
Jumpers	$19.95				

Use CAS or a spreadsheet to answer these questions.

a Enter the information in your CAS or spreadsheet and use it to evaluate the normal retail prices and discount prices for each column as indicated.

b What calculation is required in order to determine the stocktake sale price?

c What would be the percentage change between the standard discount price and the stocktake sale price of a jacket?

3.4 Simple interest applications

The simple interest formula

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Concept 3
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When you invest money and receive a return on your investment, the amount of money you receive on top of your original investment is known as the interest. Similarly, when you take out a loan, the additional amount that you pay back on top of the loan value is known as the interest.

Interest is usually calculated as a percentage of the amount that is borrowed or invested, which is known as the **principal**. **Simple interest** involves a calculation based on the original amount borrowed or invested; as a result, the amount of simple interest for a particular loan is constant. For this reason simple interest is often called 'flat rate' interest.

The formula to calculate simple interest is $I = \frac{PrT}{100}$, where I is the amount of interest earned, P is the principal (initial amount invested or borrowed), r is the interest rate and T the time period.

It is important to remember that the rate and the time must be compatible. For example, if the rate is per annum (yearly, abbreviated 'p.a.'), the time must also be in years.

The value of a simple interest investment can be evaluated by adding the total interest earned to the value of the principal.

WORKED EXAMPLE 8 Calculate the amount of simple interest earned on an investment of $4450 that returns 6.5% per annum for 3 years.

THINK	WRITE
1 Identify the components of the simple interest formula.	$P = \$4450$ $I = 6.5\%$ $T = 3$
2 Substitute the values into the formula and evaluate the amount of interest.	$I = \frac{PrT}{100}$ $= \frac{4450 \times 6.5 \times 3}{100}$ $= 867.75$
3 State the answer.	The amount of simple interest earned is $867.75.

Calculating the principal, rate or time

The simple interest formula can be transposed (rearranged) to find other missing values in problems. For example, we might want to know how long it will take for a simple interest investment of $1500 to grow to $2000 if we are being offered a rate of 7.5% per annum, or the interest rate needed for an investment to grow from $4000 to $6000 in 3 years.

The following formulas are derived from transposing the simple interest formula.

To find the time: $T = \dfrac{100I}{Pr}$

To find the interest rate: $r = \dfrac{100I}{PT}$

To find the principal: $P = \dfrac{100I}{rT}$

WORKED EXAMPLE 9 **How long will it take an investment of $2500 to earn $1100 with a simple interest rate of 5.5% p.a.?**

THINK	WRITE
1 Identify the components of the simple interest formula.	$P = 2500$ $I = 1100$ $r = 5.5$
2 Substitute the values into the formula and evaluate for T.	$T = \dfrac{100I}{Pr}$ $= \dfrac{100 \times 1100}{2500 \times 5.5}$ $= \dfrac{110000}{13750}$ $= 8$
3 State the answer.	It will take 8 years for the investment to earn $2500.

Simple interest loans

The amount of a simple interest investment can be found by adding the simple interest to the principal. This can be expressed as $A = P + I$, where A represents the total amount of the investment.

For a simple interest loan, the total interest to be paid is usually calculated when the loan is taken out, and repayments are calculated from the total amount to be paid back (i.e. the principal plus the interest). For example, if a loan is for $3000 and the total interest after 2 years is $1800, the total to be paid back will be $4800. Monthly repayments on this loan would therefore be $4800 ÷ 24 = $200.

WORKED EXAMPLE 10 **Calculate the monthly repayments for a $14 000 loan that is charged simple interest at a rate of 8.45% p.a. for 4 years.**

THINK	WRITE
1 Calculate the amount of interest charged.	$I = \dfrac{PrT}{100}$ $= \dfrac{14000 \times 8.45 \times 4}{100}$ $= 4732$

2 Add the interest to the principal to evaluate the total amount to be paid back.	$A = P + I$ $= 14000 + 4732$ $= 18732$
3 Divide by the number of months.	$\frac{18732}{48} = 390.25$
4 State the answer.	The monthly repayments will be $390.25.

Cash flow

Non-annual interest calculations

Although interest rates on investments and loans are frequently quoted in terms of an annual rate, in reality calculations on interest rates are made more frequently throughout a year. Quarterly, monthly, weekly and even daily calculations are not uncommon.

For example, a bank may offer 5% per annum on the amount its customers have in their savings accounts, but calculate the interest on a monthly basis (i.e. $\frac{5}{12}$%).

WORKED EXAMPLE 11 **How much interest is paid on a monthly balance of $665 with a simple interest rate of 7.2% p.a.?**

THINK	WRITE
1 Express the interest as a monthly rate.	$7.2\%\text{ p.a.} = \frac{7.2}{12}$ $= 0.6\%\text{ per month}$
2 Use the simple interest formula to calculate the interest.	$I = \frac{PrT}{100}$ $= \frac{665 \times 0.6 \times 1}{100}$ $= 3.99$
3 State the answer.	$3.99 interest will be paid.

Minimum balance calculations

Banks and financial institutions need to make decisions about when to apply interest rate calculations on accounts of their customers.

For investment accounts it is common practice to use the minimum balance in the account over a set period of time. An example of this is a minimum monthly balance. The following bank account calculates interest at a rate of 5.5% per annum on the minimum monthly balance.

Date	Details	Withdrawal ($)	Deposit ($)	Balance ($)
June 1	Opening balance			4101.00
June 2	EFTPOS purchase	45.50		4055.50
June 8	Deposit — Salary		550.00	4605.50
June 12	EFTPOS purchase	56.00		4549.50
June 14	ATM withdrawal	220.00		4329.50
June 15	Deposit — Salary		550.00	4879.50
June 22	Deposit — Salary		550.00	5429.50
June 23	ATM withdrawal	285.00		5144.50
June 25	Payment — Direct debit insurance	350.00		4794.50
June 28	EFTPOS purchase	189.50		4605.00
June 29	Deposit — Salary		550.00	5155.00
June 30	Interest		18.59	5173.59

The minimum balance during the month was $4055.50, so the interest calculation is made on this amount.

$$I = \frac{4055.50 \times \left(5.5 \times \frac{1}{12}\right) \times 1}{100}$$
$$= \$18.59 \text{ (correct to 2 decimal places)}$$

Notice that the balance for the month was below $4101.00 for only six days, so the timing of withdrawals and deposits is very important for customers looking to maximise the interest they receive.

WORKED EXAMPLE 12

Interest on a savings account is earned at a simple rate of 7.5% p.a. and is calculated on the minimum monthly balance. How much interest is earned for the month of June if the opening balance is $1200 and the following transactions are made? Give your answer correct to the nearest cent.

Date	Details	Amount
June 2	Deposit	$500
June 4	Withdrawal	$150
June 12	Withdrawal	$620
June 18	Deposit	$220
June 22	Withdrawal	$500
June 29	Deposit	$120

THINK	WRITE
1 Set up a balance sheet that places the transactions in chronological order. Use it to calculate the balance following each consecutive transaction.	

Date	Details	Withdrawal	Deposit	Balance
June 1	Opening balance			1200.00
June 2	Deposit		500.00	1700.00
June 4	Withdrawal	150.00		1550.00
June 12	Withdrawal	620.00		930.00
June 18	Deposit		220.00	1150.00
June 22	Withdrawal	500.00		650.00
June 29	Deposit		120.00	770.00

2 Identify the smallest balance and use this to calculate the monthly interest.

The smallest balance is $650.00.
The monthly interest is:

$$I = \frac{650 \times \left(7.5 \times \frac{1}{12}\right) \times 1}{100}$$
$$= \$4.06$$

3 State the answer.

The interest earned for the month of June is $4.06.

EXERCISE 3.4 Simple interest applications

Unless otherwise directed, give all answers to the following questions correct to 2 decimal places or the nearest cent where appropriate.

PRACTISE

1 WE8 Calculate the amount of simple interest earned on an investment of:
- a $2575, returning 8.25% per annum for 4 years
- b $12 250, returning 5.15% per annum for $6\frac{1}{2}$ years
- c $43 500, returning 12.325% per annum for 8 years and 3 months
- d $103 995, returning 2.015% per annum for 105 months.

2 Calculate the value of a simple interest investment of:
- a $500, after returning 3.55% per annum for 3 years
- b $2054, after returning 4.22% per annum for $7\frac{3}{4}$ years
- c $3500, after returning 11.025% per annum for 9 years and 3 months
- d $10 201, after returning 1.008% per annum for 63 months.

3 WE9 How long will it take an investment of:
- a $675 to earn $216 with a simple interest rate of 3.2% p.a.?
- b $1000 to earn $850 with a simple interest rate of 4.25% p.a.?
- c $5000 to earn $2100 with a simple interest rate of 5.25% p.a.?
- d $2500 to earn $775 with a simple interest rate of 7.75% p.a.?

4 a If $2000 earns $590 in 5 years, what is the simple interest rate?
- b If $1800 earns $648 in 3 years, what is the simple interest rate?
- c If $408 is earned in 6 years with a simple interest rate of 4.25%, how much was invested?
- d If $3750 is earned in 12 years with a simple interest rate of 3.125%, how much was invested?

5 WE10 Calculate the monthly repayments for:

a a $8000 loan that is charged simple interest at a rate of 12.25% p.a. for 3 years

b a $23 000 loan that is charged simple interest at a rate of 15.35% p.a. for 6 years

c a $21 050 loan that is charged simple interest at a rate of 11.734% p.a. for 6.25 years

d a $33 224 loan that is charged simple interest at a rate of 23.105% p.a. for 54 months.

6 Calculate the monthly repayments for:

a a $6225 loan that is charged simple interest at a rate of 7.025% p.a. for 130 weeks

b a $13 328 loan that is charged simple interest at a rate of 9.135% p.a. for 1095 days.

7 WE11 How much interest is paid on a monthly balance of:

a $1224 with a simple interest rate of 3.6% p.a.

b $955 with a simple interest rate of 6.024% p.a.

c $2445.50 with a simple interest rate of 4.8% p.a.

d $13 728.34 with a simple interest rate of 9.612% p.a.?

8 How much interest is paid on:

a a weekly balance of $1020 with a simple interest rate of 18% p.a.

b a quarterly balance of $12 340 with a simple interest rate of 23% p.a.

c a fortnightly balance of $22 765 with a simple interest rate of 9.5% p.a.

d a daily balance of $225 358 with a simple interest rate of 6.7% p.a.?

9 WE12 Interest on a savings account is earned at a simple rate and is calculated on the minimum monthly balance. How much interest is earned for the month of:

a January, if the rate is 4.2% p.a., the opening balance is $200 and the following transactions are made

Date	Details	Amount
3 January	Deposit	$135
6 January	Deposit	$84
14 January	Withdrawal	$44
19 January	Withdrawal	$175
25 January	Deposit	$53
30 January	Deposit	$118

b September, if the rate is 3.6% p.a., the opening balance is $885 and the following transactions are made?

Date	Details	Amount
2 September	Withdrawal	$225
4 September	Withdrawal	$150
12 September	Withdrawal	$73
18 September	Deposit	$220
22 September	Withdrawal	$568
29 September	Withdrawal	$36

10 Interest on a savings account is earned at a simple rate and is calculated on the minimum monthly balance. How much interest is earned for the month of:

a May, if the rate is 5.8% p.a., the opening balance is $465 and the following transactions are made

Date	Details	Amount
2 May	Deposit	$111
4 May	Deposit	$150
12 May	Withdrawal	$620
18 May	Deposit	$135
22 May	Deposit	$203
29 May	Deposit	$45

b October, if the rate is 2.85% p.a., the opening balance is $2240 and the following transactions are made?

Date	Details	Amount
2 October	Deposit	$300
4 October	Withdrawal	$683
12 October	Deposit	$220
18 October	Deposit	$304
22 October	Deposit	$164
29 October	Withdrawal	$736

CONSOLIDATE

11 A savings account with a minimum monthly balance of $800 earns $3.60 interest in a month. What is the annual rate of simple interest?

12 Investment 1 is $1000 growing at a simple interest rate of 4.5% p.a., and investment 2 is $800 growing at a simple interest rate of 8.8%. When will investment 2 be greater than investment 1? Give your answer correct to the nearest year.

13 $25 000 is invested for 5 years in an account that pays 6.36% p.a. simple interest.

a How much interest is earned each year?

b What will be the value of the investment after 5 years?

c If the money was reinvested for a further 2 years, what simple interest rate would result in the investment amounting to $35 000 by the end of that time?

14 A bank account pays simple interest at a rate of 0.085% on the minimum weekly balance.

a What is the annual rate of interest? (Assume 52 weeks in a year.)

b If $3.50 interest was earned, what was the minimum balance for that week?

c How much interest was earned if the opening balance for a week was $3030 and the transactions in the table at right took place?

Day	Details
Day 1	Withdrawal $250
Day 2	Deposit $750
Day 3	Withdrawal $445
Day 4	Deposit $180
Day 5	Deposit $230
Day 7	Withdrawal $650

15 An overdraft account requires a minimum payment of 5% of the outstanding balance at the end of each month. Interest on the account is calculated at a simple rate of 15.5% p.a. calculated monthly.

- **a** What is the minimum monthly payment if the overdraft balance before the interest was charged was $10 000?
- **b** What is the percentage change (relative to the initial $10 000) in the balance of the account once the minimum payment has been made?

16 A borrower has to pay 7.8% p.a. simple interest on a 6-year loan. If the total interest paid is $3744:

- **a** how much was borrowed
- **b** what are the repayments if they have to be made fortnightly?

17 $19 245 is invested in a fund that pays a simple interest rate of 7.8% p.a. for 42 months.

- **a** How much simple interest is earned on this investment?
- **b** The investor considers an alternative investment with a bank that offers a simple interest rate of 0.625% per month for the first 2.5 years and 0.665% per month after that. Which is the best investment?

18 A bank offers a simple interest loan of $35 000 with monthly repayments of $545.

- **a** What is the rate of simple interest if the loan is paid in full in 15 years?
- **b** After 5 years of payments the bank offers to reduce the total time of the loan to 12 years if the monthly payments are increased to $650. How much interest would be paid over the life of the loan under this arrangement?
- **c** What would be the average rate of simple interest over the 12 years under the new arrangement?

19 At the start of the financial year (1 July) a company opens a new account at a bank with a deposit of $25 000. The account pays simple interest at a rate of 7.2% p.a. payable on the minimum monthly balance and credited quarterly.

- **a** Calculate the total amount of interest payable if the following transactions took place.

Date	Details	Amount	Date	Details	Amount	Date	Details	Amount
July 3	Withdraw	$8340	Aug 5	Withdraw	$1167	Sep 8	Withdraw	$750
July 13	Deposit	$6206	Aug 12	Deposit	$5449	Sep 17	Deposit	$2950
July 23	Withdraw	$3754	Aug 18	Deposit	$1003	Sep 24	Withdraw	$7821
July 29	Withdraw	$4241	Aug 23	Withdraw	$5775	Sep 29	Deposit	$1057

- **b** What is the overall percentage change in the account for each month over this time period?

20 An account pays simple interest at a rate of 7.2% p.a. on the minimum daily balance and credits it to the account half-yearly.

- **a** What is the daily rate of interest?
- **b** Calculate the daily interest payable after 6 months if the account was opened with a deposit of $250 on 1 July, followed by further deposits of $350 on the first day of each subsequent month.

MASTER

21 The table shows the transactions for a savings account over a 6-month period. Simple interest of 4.5% p.a. is calculated on the minimum daily balance of the account and credited to the account every 6 months.

Use CAS or a spreadsheet to answer the following questions.

Date	Details	Amount
1/01/2016	Opening balance	$1200.00
12/01/2016	Deposit	$250.00
3/03/2016	Withdrawal	$420.00
14/04/2016	Withdrawal	$105.00
25/05/2016	Deposit	$265.00
9/06/2016	Deposit	$125.00

a Enter the details for the account into your CAS or spreadsheet and use it to calculate the balance in the account at each date.

b Use your CAS or a spreadsheet to calculate the amount of interest earned after 6 months.

22 $100 is invested in an account that earns $28 of simple interest in 8 months.

a Evaluate the annual rate of simple interest.

b Calculate the amount of interest that would have been earned in the 8 months if the annual interest rate was increased by 0.75%.

3.5 Compound interest applications

Step-by-step compounding

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Simple interest rates calculate interest on the starting value. However, it is more common for interest to be calculated on the changing value throughout the time period of a loan or investment. This is known as compounding.

In compounding, the interest is added to the balance, and then the next interest calculation is made on the new value.

For example, consider an investment of $5000 that earns 5% p.a. compounding annually. At the end of the first year, the interest amounts to $\frac{5}{100} \times 5000 = \$250$, so the total investment will become $5250. At the end of the second year, the interest now amounts to $\frac{5}{100} \times 5250 = \$262.50$. As time progresses, the amount of interest becomes larger at each calculation. In contrast, a simple interest rate calculation on this balance would be a constant, unchanging amount of $250 each year.

WORKED EXAMPLE 13

A bank offers its customers a compound interest rate of 6.8% p.a. on term deposits for amounts over $3000, as long as the balance remains in the account for a minimum of 2 years. Calculate the amount of compound interest accumulated after 2 years on a term deposit of $3500 correct to the nearest cent.

THINK	WRITE
1 Calculate the interest at the end of the first year.	$\frac{6.8}{100} \times 3500 = 238$

2 Add the interest after the first year to the principal.	$3500 + 238 = 3738$
3 Use the principal plus the first year's interest to calculate the interest at the end of the second year.	$\frac{6.8}{100} \times 3738 = 254.18$ (to 2 decimal places)
4 Add the interest after the first year to the interest after the second year.	$238 + 254.18 = 492.18$
5 State the answer.	After 2 years the amount of compound interest accumulated is \$492.18.

The compound interest formula

Although **compound interest** can be calculated step-by-step as shown above, it is usually easier to calculate compound interest by using the following formula:

$$A = P\left(1 + \frac{r}{100}\right)^n$$

where A is the final amount, P is the principal, r is the rate of interest per period and n is the number of compounding periods.

As with the simple interest formula, we need to ensure that the rate of interest and the number of compounding periods are compatible.

If we want to find the amount of compound interest, we need to subtract the principal from the final amount at the end of the compounding periods.

$$I = A - P$$

WORKED EXAMPLE 14 **Use the compound interest formula to calculate the amount of interest on an investment of \$2500 at 3.5% p.a. compounded annually for 4 years, correct to the nearest cent.**

THINK	WRITE
1 Identify the components of the compound interest formula.	$P = 2500$ $r = 3.5$ $n = 4$
2 Substitute the values into the formula and evaluate the amount of the investment.	$A = P\left(1 + \frac{r}{100}\right)^n$ $= 2500\left(1 + \frac{3.5}{100}\right)^4$ $= 2868.81$ (to 2 decimal places)
3 Subtract the principal from the final amount of the investment to calculate the interest.	$I = A - P$ $= 2868.81 - 2500$ $= 368.81$
4 State the answer.	The amount of compound interest is \$368.81.

Calculating the interest rate or principal

As with the simple interest formula, the compound interest formula can be transposed if we need to find the interest rate or principal required to answer a particular problem. Transposing the compound interest formula gives the following formulas.

To find the interest rate:

$$r = 100\left(\left(\frac{A}{P}\right)^{\frac{1}{n}} - 1\right)$$

To find the principal:

$$P = \frac{A}{\left(1 + \frac{r}{100}\right)^{n}}$$

WORKED EXAMPLE 15 **Use the compound interest formula to calculate the principal required, correct to the nearest cent, to have a final amount of $10 000 after compounding at a rate of 4.5% p.a. for 6 years.**

THINK	WRITE
1 Identify the components of the compound interest formula.	$A = \$10000$ $r = 4.5$ $n = 6$
2 Substitute the values into the formula to evaluate the principal.	$P = \frac{A}{\left(1 + \frac{i}{100}\right)^{n}}$ $= \frac{10\,000}{\left(1 + \frac{4.5}{100}\right)^{6}}$ $= 7678.96$ (to 2 decimal places)
3 State the final answer.	The principal required is $7678.96.

Note: It is also possible to transpose the compound interest formula to find the number of compounding periods (n), but this requires logarithms and is outside the scope of this course.

Non-annual compounding

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Interest rates are usually expressed per annum (yearly), but compounding often takes place at more regular intervals, such as quarterly, monthly or weekly. When this happens, adjustments need to be made when applying the formula to ensure that the rate is expressed in the same period of time. For example:

Compounding monthly: $A = P\left(1 + \frac{r}{1200}\right)^{n}$

Compounding weekly: $A = P\left(1 + \frac{r}{5200}\right)^{n}$

WORKED EXAMPLE 16 **Use the compound interest formula to calculate the amount of interest accumulated on $1735 at 7.2% p.a. for 4 years if the compounding occurs monthly. Give your answer correct to the nearest cent.**

THINK	WRITE
1 Identify the components of the compound interest formula.	$P = \$1735$ $r = 7.2$ $n = 48$ (monthly periods)
2 Substitute the values into the formula and evaluate the amount.	$A = P\left(1 + \frac{r}{1200}\right)^n$ $= 1735\left(1 + \frac{7.2}{1200}\right)^{48}$ $= 2312.08$ (to 2 decimal places)
3 Subtract the principal from the amount of the investment.	$I = A - P$ $= 2312.08 - 1735$ $= 577.08$
4 State the answer.	The amount of interest accumulated is $577.08.

Inflation

Inflation is a term used to describe a general increase in prices over time that effectively decreases the purchasing power of a currency. Inflation can be measured by the inflation rate, which is an annual percentage change of the **Consumer Price Index (CPI)**.

Inflation needs to be taken into account when analysing profits and losses over a period of time. It can be analysed by using the compound interest formula.

Spending power

As inflation increases, the **spending power** of a set amount of money will decrease. For example, if the cost of a loaf of bread was $4.00 and rose with the rate of inflation, in 5 years it might cost $4.50. As inflation gradually decreases the spending of the dollar, people's salaries often increase in line with inflation. This counterbalances the decreasing spending power of money.

WORKED EXAMPLE 17 **An investment property is purchased for $300 000 and is sold 3 years later for $320 000. If the average annual inflation is 2.5% p.a., has this been a profitable investment?**

THINK	WRITE
1 Recall that inflation is an application of compound interest and identify the components of the formula.	$P = 300\,000$ $r = 2.5$ $n = 3$

2 Substitute the values into the formula and evaluate the amount.	$A = P\left(1 + \frac{r}{100}\right)^n$ $= 300\,000\left(1 + \frac{2.5}{100}\right)^3$ $= 323\,067.19$ (to 2 decimal places)
3 Compare the inflated amount to the selling price.	Inflated amount: \$323 067.19 Selling price: \$320 000
4 State the answer.	This has not been a profitable investment, as the selling price is less than the inflated purchase price.

EXERCISE 3.5 Compound interest applications

Unless otherwise directed, where appropriate give all answers to the following questions correct to 2 decimal places or the nearest cent.

PRACTISE

1 WE13 A bank offers its customers a compound interest rate on term deposits for amounts over \$3000 as long as the balance remains in the account for a minimum of 2 years. Calculate the amount of compound interest after:

- **a** 3 years on a term deposit of \$5372 at 7.32% p.a.
- **b** 4 years on a term deposit of \$9550 at 2.025% p.a.
- **c** 5 years on a term deposit of \$10 099 at 1.045% p.a.

2 Calculate the value of an investment of \$1500 after 3 years at a compound interest rate of 2.85% p.a.

3 WE14 Use the compound interest formula to calculate the amount of compound interest on an investment of:

- **a** \$4655 at 4.55% p.a. for 3 years
- **b** \$12 344 at 6.35% p.a. for 6 years
- **c** \$3465 at 2.015% p.a. for 8 years
- **d** \$365 000 at 7.65% p.a. for 20 years.

4 Use the compound interest formula to find the future amount of:

- **a** \$358 invested at 1.22% p.a. for 6 years
- **b** \$1276 invested at 2.41% p.a. for 4 years
- **c** \$4362 invested at 4.204% p.a. for 3 years
- **d** \$275 950 invested at 6.18% p.a. for 16 years.

5 WE15 Use the compound interest formula to calculate the principal required to yield a final amount of:

- **a** \$15 000 after compounding at a rate of 5.25% p.a. for 8 years
- **b** \$22 500 after compounding at a rate of 7.15% p.a. for 10 years
- **c** \$1000 after compounding at a rate of 1.25% p.a. for 2 years
- **d** \$80 000 after compounding at a rate of 6.18% p.a. for 15 years.

6 Use the compound interest formula to calculate the compound interest rate p.a. that would be required to grow:

- **a** \$500 to \$1000 in 2 years
- **b** \$850 to \$2500 in 3 years
- **c** \$1600 to \$2900 in 4 years
- **d** \$3490 to \$9000 in 3 years.

7 WE16 Use the compound interest formula to calculate the amount of interest accumulated on:

- **a** \$2876 at 3.12% p.a. for 2 years, if the compounding occurs monthly
- **b** \$23 560 at 6.17% p.a. for 3 years, if the compounding occurs monthly

c $85.50 at 2.108% p.a. for 2 years, if the compounding occurs monthly
d $12 345 at 5.218% p.a. for 6 years, if the compounding occurs monthly.

8 Use the compound interest formula to calculate the final amount for:

a $675 at 2.42% p.a. for 2 years compounding weekly
b $4235 at 6.43% p.a. for 3 years compounding quarterly
c $85 276 at 8.14% p.a. for 4 years compounding fortnightly
d $53 412 at 4.329% p.a. for 1 years compounding daily.

9 WE17 An investment property is purchased for $325 000 and is sold 5 years later for $370 000. If the average annual inflation is 2.73% p.a., has this been a profitable investment?

10 A business is purchased for $180 000 and is sold 2 years later for $200 000. If the annual average inflation is 1.8% p.a., has a real profit been made?

CONSOLIDATE

11 An $8000 investment earns 7.8% p.a. compound interest over 3 years. How much interest is earned if the amount is compounded:

a annually **b** monthly **c** weekly **d** daily?

12 a Calculate the interest accrued on a $2600 investment attracting a compound interest rate of 9.65% compounded annually. Show your results in the following table.

Year	1	2	3	4	5	6	7	8
Interest accrued ($)								

b Show your results in a graph.

13 Use a spreadsheet and graph to compare $4000 compounding at a rate of 3.25% p.a. with $2000 compounding at a rate of 6.5% p.a. When is the second option worth more as an investment than the first?

14 A parking fine that was originally $65 requires the payment of an additional late fee of $35. If the fine was paid 14 days late and interest had been compounding daily, what was the annual rate of interest being charged?

15 A person has $1000 and wants to have enough to purchase something worth $1450.

a If they invest the $1000 in a bank account paying compound interest monthly and the investment becomes $1450 within 3 years, what interest rate is the account paying?
b If the price of the item increased in line with an average annual inflation rate of 2%, how much would the person have needed to invest to have enough to purchase it at the end of the same time period, using the same compound rate of interest as in part **a**?

16 Shivani is given $5000 by her grandparents on the condition that she invests it for at least 3 years. Her parents help her to find the best investment options and come up with the following choices.

- **i** A local business promising a return of 3.5% compounded annually, with an additional 2% bonus on the total sum paid at the end of the 3-year period
- **ii** A building society paying a fixed interest rate of 4.3% compounded monthly
- **iii** A venture capitalist company guaranteeing a return of 3.9% compounded daily

a Calculate the expected return after 3 years for each of the options.

b Assuming each option is equally secure, where should Shivani invest her money?

17 The costs of manufacturing a smart watch decrease by 10% each year.

a If the watch initially retails at $200 and the makers decrease the price in line with the manufacturing costs, how much will it cost at the end of the first 3 years?

b Inflation is at a steady rate of 3% over each of these years, and the price of the watch also rises with the rate of inflation. Recalculate the cost of the watch for each of the 3 years according to inflation. (*Note:* Apply the manufacturing cost decrease before the inflation price increase.)

18 In 2006 Matthew earned approximately $45 000 after tax and deductions. In 2016 he earned approximately $61 000 after tax and deductions. If inflation over the 10-year period from 2006 to 2016 averaged 3%, was Matthew earning comparatively more in 2006 or 2016?

19 Francisco is a purchaser of fine art, and his two favourite pieces are a sculpture he purchased in 1998 for $12 000 and a series of prints he purchased in 2007 for $17 000.

a If inflation averaged 3.3% for the period between 1998 and 2007, which item cost more in real terms?

b The value of the sculpture has appreciated at a rate of 7.5% since 1998, and the value of the prints has appreciated at a rate of 6.8% since 2007. How much were they both worth in 2015? Round your answers correct to the nearest dollar.

20 Use the compound interest formula to complete the following table. Assume that all interest is compounded annually.

Principal ($)	Final amount ($)	Interest earned	Interest rate (p.a.)	Number of years
11 000	12 012.28			2
14 000			3.25	3
22 050	25 561.99	3511.99		5
		2700.00	2.5	1

MASTER

21 **a** Using CAS, tabulate and graph an investment of $200 compounding at rate of 6.1% p.a. over 25 years.

b Evaluate, giving your answers to the nearest year, how long it will take the investment to:

i double **ii** triple **iii** quadruple.

22 Using CAS, compare compounding annually with compounding quarterly for $1000 at a rate of 12% p.a. over 5 years.

a Show the information in a graph or a table.

b What is the effect of compounding at regular intervals during the year while keeping the annual rate the same?

3.6 Purchasing options

Cash purchases

studyon

Units 1 & 2
AOS 2
Topic 2
Concept 6

Purchasing options
Concept summary
Practice questions

Buying goods with cash is the most straightforward purchase a person can make. The buyer owns the goods outright and no further payments are necessary. Some retailers or services offer a discount if a customer pays with cash.

WORKED EXAMPLE 18

A plumber offers a 5% discount if his customers pay with cash. How much would a customer be charged if they paid in cash and the fee before the discount was $139?

THINK	WRITE
1 Determine the percentage of the fee that the customer will pay after the discount is taken into account.	$100\% - 5\% = 95\%$
2 Multiply the fee before the discount by the percentage the customer will pay. Turn the percentage into a fraction.	$139 \times 95\% = 139 \times \frac{95}{100}$
3 Evaluate the amount to be paid.	$= 132.05$
4 Write the answer.	The customer will be charged $132.05.

Credit and debit cards

Credit cards

A **credit card** is an agreement between a financial institution (usually a bank) and an individual to loan an amount of money up to a pre-approved limit. Credit cards can be used to pay for transactions until the amount of debt on the credit card reaches the agreed limit of the credit card.

If a customer pays off the debt on their credit card within a set period of time after purchases are made, known as an interest-free period, they will pay no interest on the debt. Otherwise they will pay a high interest rate on the debt (usually 20–30% p.a.), with the interest calculated monthly. Customers are obliged to pay at least a minimum monthly amount off the debt, for example 3% of the balance.

Credit cards often charge an annual fee, but customers can also earn rewards from using credit cards, such as frequent flyer points for major airlines or discounts at certain retailers.

Debit cards

Debit cards are usually linked to bank accounts, although they can also be pre-loaded with set amounts of money. When a customer uses a debit card the money is debited directly from their bank account or from the pre-loaded amount.

If a customer tries to make a transaction with a debit card that exceeds the balance in their bank account, then either their account will become overdrawn (which typically incurs a fee from the banking facility), or the transaction will be declined.

WORKED EXAMPLE 19

Heather has a credit card that charges an interest rate of 19.79% p.a. She tries to ensure that she always pays off the full amount at the end of the interest-free period, but an expensive few months over the Christmas holidays leaves the outstanding balance on her card at $635, $427 and $155 for three consecutive months. Calculate the total amount of interest Heather has to pay over the three-month period. Give your answer correct to the nearest cent.

THINK

1 Use the simple interest formula to determine the amount of interest charged each month.

WRITE

1st month:

$$I = \frac{PrT}{100}$$
$$= \frac{635 \times 19.79 \times \frac{1}{12}}{100}$$
$$\approx 10.47$$

2nd month:

$$I = \frac{PrT}{100}$$
$$= \frac{427 \times 19.79 \times \frac{1}{12}}{100}$$
$$\approx 7.04$$

3rd month:

$$I = \frac{PrT}{100}$$
$$= \frac{155 \times 19.79 \times \frac{1}{12}}{100}$$
$$\approx 2.56$$

2 Calculate the sum of the interest for the three months.

$10.47 + 7.04 + 2.56 = 20.07$

3 Write the answer.

Heather has to pay $20.07 in interest over the three-month period.

Personal loans

A **personal loan** is a loan made by a lending institution to an individual. A personal loan will usually have a fixed interest rate attached to it, with the interest paid by the customer calculated on a reduced balance. This means that the interest for each period will be calculated on the amount still owing, rather than the original amount of the loan.

WORKED EXAMPLE 20

Frances takes out a loan of $3000 to help pay for a business management course. The loan has a fixed interest rate of 7.75% p.a. and Francis agrees to pay back $275 a month. Assuming that the interest is calculated before Francis's payments, calculate the outstanding balance on the loan after Francis's third payment. Give your answer correct to the nearest cent.

THINK	WRITE
1 Calculate the interest payable for the first month of the loan.	$I = \frac{PrT}{100}$ $= \frac{3000 \times 7.75 \times \frac{1}{12}}{100}$ ≈ 19.38
2 Calculate the total value of the loan before Francis's first payment.	$\$3000 + \$19.38 = \$3019.38$
3 Calculate the total value of the loan after Francis's first payment.	$\$3019.38 - \$275 = \$2744.38$
4 Calculate the interest payable for the second month of the loan.	$I = \frac{PrT}{100}$ $= \frac{2744.38 \times 7.75 \times \frac{1}{12}}{100}$ ≈ 17.72
5 Calculate the total value of the loan before Francis's second payment.	$\$2774.38 + \$17.72 = \$2792.10$
6 Calculate the total value of the loan after Francis's second payment.	$\$2792.10 - \$275 = \$2517.10$
7 Calculate the interest payable for the third month of the loan.	$I = \frac{PrT}{100}$ $= \frac{2517.1 \times 7.75 \times \frac{1}{12}}{100}$ ≈ 16.26
8 Calculate the total value of the loan before Francis's third payment.	$\$2517.10 + \$16.26 = \$2533.36$

9 Calculate the total value of the loan after Francis's third payment.	$2533.36 − $275 = $2258.36
10 Write the answer.	The outstanding balance of the loan after Francis's third payment is $2258.36.

Time payments (hire purchase)

A **time payment**, or hire purchase, can be used when a customer wants to make a large purchase but doesn't have the means to pay up front. Time payments usually work by paying a small amount up front, and then paying weekly or monthly instalments.

The effective rate of interest

The interest rate of a time payment can be determined by using the simple interest formula. However, the actual interest rate will be higher than that calculated, as these calculations don't take into account the reducing balance owing after each payment has been made.

The **effective rate of interest** can be used to give a more accurate picture of how much interest is actually charged on time payments. To determine this we can use the following formula:

$$R_{ef} = \frac{2400I}{P(m+1)}$$

where R_{ef} is the effective rate of interest, I is the total interest paid, P is the principal (the cash price minus the deposit) and m is the number of monthly payments.

WORKED EXAMPLE 21

A furniture store offers its customers the option of purchasing a $2999 bed and mattress by paying $500 up front, followed by 12 monthly payments of $230.

a How much does a customer pay in total if they choose the offered time payment plan?

b What is the effective rate of interest for the time payment plan correct to 2 decimal places?

THINK	WRITE
a 1 Determine the total amount to be paid under the time payment plan.	a Total payment $= 500 + 12 \times 230$ $= 500 + 2760$ $= 3260$
2 Write the answer.	The total amount paid under the time payment plan is $3260.
b 1 Calculate the total amount of interest paid.	b $I = 3260 - 2999$ $= 261$

2 Calculate the principal (the cash price minus the deposit).	$P = 2999 - 500$ $= 2499$
3 Identify the components of the formula for the effective rate of interest.	$I = 261$ $P = 2499$ $m = 12$
4 Substitute the information into the formula and determine the effective rate of interest.	$R_{ef} = \frac{2400I}{2499(m + 1)}$ $= \frac{2400 \times 261}{2499(12 + 1)}$ $= 19.28\%$ (to 2 decimal places)
5 Write the answer.	The effective rate of interest for the time purchase plan is 19.28%.

EXERCISE 3.6 Purchasing options

Unless otherwise directed, where appropriate give all answers to the following questions correct to 2 decimal places or the nearest cent.

PRACTISE

1 WE18 An electrician offers a discount of 7.5% if his customers pay by cash. How much will his customers pay in cash if the charge before the discount being applied is:

a $200 **b** $312 **c** $126?

2 George runs a pet-care service where he looks after cats and dogs on weekend afternoons. He charges a fee of $20 per pet plus $9 per hour. He also gives his customers a 6% discount if they pay in cash.

Charlene asks George to look after her two cats between 1 pm and 5 pm on a Saturday afternoon. How much would she have to pay if she paid in cash?

A $33.85 **B** $52.65 **C** $71.45
D $72.95 **E** $73.85

3 WE19 Barney is struggling to keep control of his finances and starts to use his credit card to pay for purchases. At the end of three consecutive months his outstanding credit card balance is $311.55, $494.44 and $639.70 respectively. If the interest rate on Barney's credit card is 22.75% p.a., calculate how much interest he is charged for the three-month period.

4 Dawn uses her credit card while on an overseas trip and returns with an outstanding balance of $2365.24 on it. Dawn can only afford to pay the minimum monthly balance of $70.96 off her credit card before the interest-free period expires.

a Dawn's credit card charges an interest rate of 24.28% p.a. How much will Dawn be charged in interest for the next month?

b If Dawn spent $500 less on her overseas trip, by how much would the interest she would be charged on her credit card be reduced? (*Note:* Assume that Dawn still pays $70.96 off her credit card.)

5 WE20 Petra takes out a loan of $5500 to help pay for a business management course. The loan has a fixed interest rate of 6.85% p.a. and Petra agrees to pay back $425 a month. Assuming that the interest is calculated before Petra's payments, calculate the outstanding balance on the loan after her third payment.

6 Calculate the total amount of interest paid on a $2500 personal loan if the rate is 5.5% p.a. and $450 is paid off the loan each month. (Assume that the interest is calculated before the monthly payments.)

7 WE21 A car dealership offers its customers the option of purchasing a $13 500 car by paying $2500 up front, followed by 36 monthly payments of $360.

a How much does a customer pay in total if they choose the time payment plan?
b What is the effective rate of interest for the time payment plan?

8 Georgie is comparing purchasing plans for the latest 4K television. The recommended retail price of the television is $3500. She goes to three stores and they offer her the following time payment plans.

- Store 1: $250 up front + 12 monthly payments of $300
- Store 2: 24 monthly payments of $165
- Store 3: $500 up front + 6 monthly payment of $540

a Calculate the total amount payable for each purchase plan.
b Which purchase plan has the lowest effective rate of interest?

CONSOLIDATE

9 A car is purchased with a deposit of $1500, which is 10% of the cash purchase price, followed by three annual instalments of $6000.

a What is the total interest that is charged over the 3 years to purchase the car this way?
b Ignoring the effect of the annual payments on the balance owed, use the total interest for the 3 years, the total instalments and the amount that was borrowed (i.e. the cash price less the deposit) to calculate the annual rate of compound interest.

10 Drew has a leak in his water system and gets quotes from 5 different plumbers to try to find the best price for the job. From previous experience he believes it will take a plumber 90 minutes to fix his system. Calculate approximately how much each plumber will charge to help Drew decide which to go with.

- Plumber A: A call-out fee of $100 plus an hourly charge of $80, with a 5% discount for payment in cash
- Plumber B: A flat fee of $200 with no discount
- Plumber C: An hourly fee of $130, with a 10% discount for payment in cash
- Plumber D: A call-out fee of $70 plus an hourly fee of $90, with an 8% discount for payment in cash
- Plumber E: An hourly fee of $120 with no discount

11 Items in an online store advertised for more than $100 can be purchased for a 12.5% deposit, with the balance payable 9 months later at a rate of 7.5% p.a. compounding monthly. How much do the following items cost the purchaser under this arrangement?

a A sewing machine advertised at $150
b A portable air conditioner advertised at $550
c A treadmill advertised at $285
d A BBQ advertised at $675

12 Divya's credit card has a low interest rate of 13.55% p.a. but has no interest-free period on purchases. Calculate the total interest she has to pay after making the following purchases.

- New sound system — $499 — paid back after 7 days
- 3 Blu-Ray films — $39 — paid back after 12 days
- Food shopping — $56 — paid back after 2 days
- Coffee machine — $85 — paid back after 18 days

13 Shawna takes out a personal loan of $4000 to help support her brother in a new business venture. The loan has a fixed interest rate of 9.15% calculated on the reduced monthly balance, and Shawna agrees to pay $400 back per month.

a How much interest will Shawna pay over the lifetime of the loan?
Shawna's brother's business goes well, and he is able to pay her back the $4000 after 1 year with 30% interest.

b How much does in total does Shawna earn from taking out the loan?

14 An electrical goods store allows purchasers to buy any item priced at $1000 or more for a 10% deposit, with the balance payable 6 months later at a simple interest rate of 7.64% p.a. Find the final cost of each of the following items under this arrangement.

a An entertainment system priced at $1265
b A dishwasher priced at $1450
c A refrigerator priced at $2018
d A security system priced at $3124

15 Elise gets a new credit card that has an annual fee of $100 and earns 1 frequent flyer point per $1 spent. In her first year using the card she spends $27 500 and has to pay $163 in interest on the card. Elise exchanged the frequent flyer points for a gift card to her favourite store, which values each point as being worth 0.8 cents. Was using the credit card over the year a profitable investment?

16 A new outdoor furniture set normally priced at $1599 is sold for an up-front fee of $300 plus 6 monthly instalments of $240. The effective rate of interest is:

A 27.78%
B 30.23%
C 31.51%
D 37.22%
E 43.42%

17 Michelle uses all of the $12 000 in her savings account to buy a new car worth $25 000 on a time payment scheme. The purchase also requires 24 monthly payments of $750.

a How much does Michelle pay in total for the car?

Michelle gets a credit card to help with her cash flow during this 24-month period, and over this time her credit card balance averages $215 per month. The credit card has an interest rate of 23.75% p.a.

b How much in interest does Michelle pay on her credit card over this period?

c In another 18 months Michelle could have saved the additional $13 000 she needed to buy the car outright. How much would she have saved by choosing to save this money first?

18 Javier purchases a new kitchen on a time payment plan. The kitchen usually retails for $24 500, but instead Javier pays an up-front fee of $5000 plus 30 monthly instalments of $820.

a How much does Javier pay in total?

b What is the effective rate of interest of the time payment plan?

If Javier paid an up-front fee of $10 000, he would only have to make 24 monthly instalments of $710.

c How much would Javier save by going for the second plan?

d What is the effective rate of interest of the second plan?

MASTER

19 **a** Using CAS, calculate the time it will take to pay back a $10 000 loan with an interest rate of 6.55% p.a. on a reducing monthly balance when paying back $560 per month.

b How much interest is payable over the lifetime of the loan?

20 Kara takes out a $12 000 loan to invest in the stock of a friend's company. The loan has an interest rate of 7.24% on a reducing monthly balance. Kara pays $720 per month.

a Using CAS, calculate the total interest that Kara has to pay over the lifetime of the loan.

b The stock that Kara invests in grows at a rate of 9.35% p.a. for the first 3 years of Kara's investment. How much did she earn in these 3 years, taking into account the interest payable on the loan she took out?

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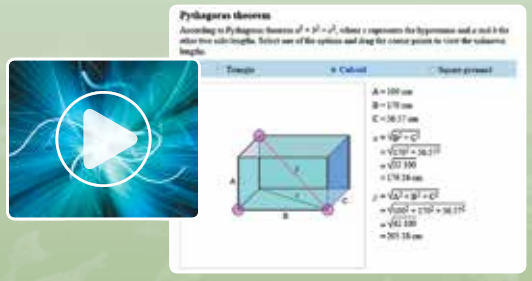

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Units 1 & 2 **Financial arithmetic**

Sit topic test

3 Answers

EXERCISE 3.2

1 a 22.64% increase
b 56.60% increase
c 26.42% decrease
d 13.96% decrease

2 a 2.70% decrease
b 18.25% decrease
c 130.77% increase
d 12.5% decrease

3 a $37.80
b $108
c $174.49
d $42 304.22

4 a $45.36
b $7.41
c $69.31
d $12 037.52

5 a $18.92
b 5.16% decrease

6 a 12.5%
b 16.88%

7 $150

8 a i 0.62%
ii 2.5%
b 1.23%

9 The first car has the largest percentage reduction at 20.05%.

10 a Perth has the largest increase of 72.16%.
b Sydney has the smallest percentage change with a decrease of 14.34%.

11 An overall increase of 9%

12 30%

13 a 18%
b $1337.33

14 a 0.78% decrease
b 44.31% increase
c 29.15% increase

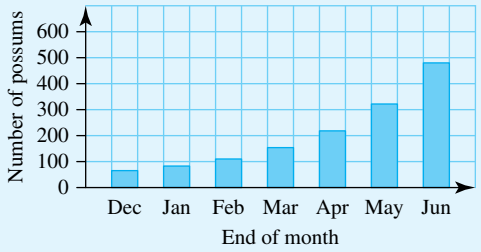
15 a

Year	Annual salary	Percentage change
2013	$34 000	
2014	$35 750	5.15%
2015	$38 545	7.82%
2016	$42 280	9.69%
2017	$46 000	8.80%

b 2016

16 a

End of month	Number of possums
Dec	65
Jan	83
Feb	110
Mar	153
Apr	219
May	321
Jun	480



b

End of month	Number of possums	Percentage change
Dec	65	
Jan	83	27.7%
Feb	110	32.5%
Mar	153	39.1%
Apr	219	43.1%
May	321	46.6%
Jun	480	49.5%

EXERCISE 3.3

1 a 6 cents/share
b 13 cents/share
c $31.50/share

2 a 3 655 944 shares
b 1 395 444 shares
c 592 840 shares
d 429 784 shares

3 a 6.37%
b 3.89%
c 5.14%
d 8.62%

4 D

5 a 50
b 34.88
c 24.07
d 15.24

6 a $15.23
b $29.81
c $27.46
d $40.70

7 a 6.82%
b 15.22%

8 3.11%

9 a $3.18
b $53.35
c $5124.35
d $0.21

10 Company A by $167

11 a 34 cents/share
b $1.20/share
c 83 cents/share
d $3.92/share

12 a $602.80
b 13.59%

13 a $4.28
b 10.13

14 a $4227
b 36.17%

15 a Company A: $1.16; Company B: $0.19
b Company A: 29.74; Company B: 7.79

c $770

d Company B

16 a 10 506 240 rand b 16.32

17 a $1.56 b $1.38

c $27.86

18 a $36 857.15 b 5.04%

19 a, b

Year	Net profit	Price-to-earnings ratio
2012	$26 615 384.62	25.72
2013	$50 000 000.00	12.25
2014	$42 153 846.15	15.04
2015	$48 461 538.46	10.10
2016	$52 615 384.62	8.65

c 2016

20 $0.84

21 a Company A: 15.99, Company B: 15.86, Company C: 17.23, Company D: 15.34, Company E: 19.66

b Company A: 6.25%, Company B: 6.31%, Company C: 5.80%, Company D: 6.52%, Company E: 5.09%

22 a See the table at the foot of the page.*

b Normal retail price × 0.45

c 48.57%

EXERCISE 3.4

1 a $849.75 b $4100.69

c $44 231.34 d $18 335.62

2 a $553.25 b $2725.76

c $7069.34 d $10 740.84

3 a 10 years b 20 years

c 8 years d 4 years

4 a 5.9% b 12%

c $1600 d $10 000

5 a $303.89 b $613.65

c $486.50 d $1254.96

6 a $243.94 b $471.68

7 a $3.67 b $4.79

c $9.78 d $109.96

8 a $3.53 b $709.55

c $83.18 d $41.37

9 a $0.70 b $0.16

10 a $0.51 b $4.30

11 5.4%

12 In the 8th year

13 a $1590 b $32 950

c 3.11%

14 a 4.42% b $4117.65

c $2.36

15 a $506.46 b 3.77%

16 a $8000 b $75.28

17 a $5253.89

b The first investment is the best (7.8% p.a.).

18 a 12.02% b $52 300

c 12.45%

19 a $224.01

b July: 40.52% reduction, August: 3.30% reduction, September: 31.74% reduction

20 a 0.02% per day b $41.33

21 a

Date	Balance
01/01/16	$1200
12/01/16	$1450
03/03/16	$1030
14/04/16	$925
25/05/16	$1190
09/09/16	$1315

b $26.53

22 a 42% p.a. b $28.50

*22 a

Item	Cost price	Normal retail price (255% mark-up)	Standard discount (12.5% mark-down of normal retail price)	January sale (32.25% mark-down of normal retail price)	Stocktake sale (55% mark-down of normal retail price)
Socks	$1.85	$6.57	$5.75	$4.45	$2.96
Shirts	$12.35	$43.84	$38.36	$29.70	$19.73
Trousers	$22.25	$78.99	$69.12	$53.52	$35.55
Skirts	$24.45	$86.80	$75.95	$58.81	$39.06
Jackets	$32.05	$113.78	$99.56	$77.09	$51.20
Ties	$5.65	$20.06	$17.55	$13.59	$9.03
Jumpers	$19.95	$70.82	$61.97	$47.98	$31.87

EXERCISE 3.5

1 a $1268.15 **b** $797.37
c $538.82

2 $1631.94

3 a $664.76 **b** $5515.98
c $599.58 **d** $1 229 312.85

4 a $385.02 **b** $1403.52
c $4935.59 **d** $720 300.86

5 a $9961.26 **b** $11 278.74
c $975.46 **d** $32 542.37

6 a 41.42% **b** 43.28%
c 16.03% **d** 37.13%

7 a $184.93 **b** $4777.22
c $3.68 **d** $4526.95

8 a $708.47 **b** $5128.17
c $118 035.38 **d** $55 774.84

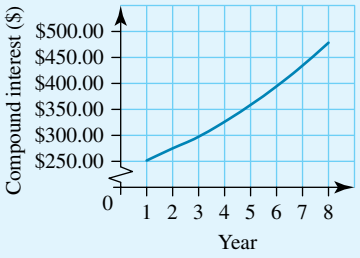
9 The inflated value is $371 851.73, so it is barely profitable.

10 The inflated value is $186 538.32, so it is profitable.

11 a $2021.81 **b** $2101.50
c $2107.38 **d** $2108.90

12 a See the table at the foot of the page.*

b



13 The second option will be worth more after 23 years.

14 1140.57% p.a.

15 a 12.45% p.a.
b $1061.19

16 a **i** $5654.46 **ii** $5687.14 **iii** $5620.56
b Shivani should invest her money with the building society.

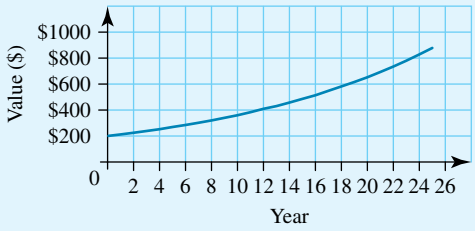
17 a Year 1: $180, Year 2: $162, Year 3: $145.80
b Year 1: $185.40, Year 2: $171.86, Year 3: $159.32

18 2016

19 a The series of prints
b Sculpture: $41 032, prints: $28 775

20 See the table at the foot of the page.*

21 a See the table at the foot of the page.*



b **i** 12 years
ii 19 years
iii 24 years

---

*12 a

Year	1	2	3	4	5	6	7	8
Interest accrued ($)	250.90	275.11	301.66	330.77	362.69	397.69	436.07	478.15

*20

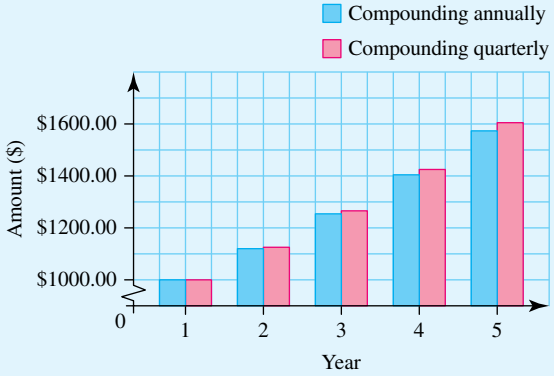
Principal ($)	Final amount ($)	Interest earned ($)	Interest rate (p.a.)	Number of years
11 000	12 012.28	**1012.28**	**4.5**	2
14 000	**15 409.84**	**1409.84**	3.25	3
22 050	25 561.99	3511.99	**3**	5
108 000	**110 070.00**	2700.00	2.5	1

*21 a

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Value ($)	200.00	212.20	225.14	238.88	253.45	268.91	285.31	302.72	321.18	340.78	361.56	383.62	407.02

Year	13	14	15	16	17	18	19	20	21	22	23	24	25
Value ($)	431.85	458.19	486.14	515.79	547.26	580.64	616.06	653.64	693.51	735.81	780.70	828.32	878.85

22 a See the table at the foot of the page.*



Note: The graph shows the amounts at the beginning of each year.

b Compounding at regular intervals during the year accumulates more interest than compounding only once a year.

EXERCISE 3.6

1 a $185 **b** $288.60 **c** $116.55

2 C

3 $27.41

4 a $46.42 **b** $10.12

5 $4312.44

6 $38.42

7 a $15 460 **b** 11.56%

8 a Store 1: $3850 **b** Store 2
Store 2: $3960
Store 3: $3740

9 a $4500 **b** 10.06%

10 Plumber C

11 a $157.57 **b** $577.76
c $299.38 **d** $709.07

12 $2.08

13 a $176.94 **b** $1023.06

14 a $1308.49 **b** $1499.85
c $2087.38 **d** $3231.40

15 No, Elise loses $43.

16 D

17 a $30 000 **b** $102.13
c $5102.13

18 a $29 600 **b** 20.25%
c $2560 **d** 16.82%

19 a 19 months **b** $540.42

20 a $685.72 **b** $3004.81

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*22 a

Compounding annually	
Year	**Amount**
1	$1000.00
2	$1120.00
3	$1254.40
4	$1404.93
5	$1573.52

Compounding quarterly	
Quarter	**Amount**
1	$1000.00
2	$1030.00
3	$1060.90
4	$1092.73
5	$1125.51
6	$1159.27
7	$1194.05
8	$1229.87
9	$1266.77
10	$1304.77
11	$1343.92
12	$1384.23
13	$1425.76
14	$1468.53
15	$1512.59
16	$1557.97
17	$1604.71
18	$1652.85
19	$1702.43
20	$1753.51